CONTINUOUS MOTION CONTROLS OPERABLE USING NEUROLOGICAL DATA

BACKGROUND

[0001] Neurological data can be gathered through a variety of techniques. One non-invasive technique is electroencephalography (EEG), which involves the placement of electrodes along the scalp of a user or subject to measure voltage fluctuations resulting from ionic current within the neurons of the brain. EEG is often used in clinical contexts to monitor sleep patterns or to diagnose epilepsy.

[0002] Computer system user interfaces typically include a variety of user interface controls enabling a user to interact with the computer system through the user interface. In most circumstances, the user interface controls rely on various input/output devices, such as keyboards, touchpads, mouse controls, game controllers, and other devices typically requiring the user to use his/her hands, other body part to physically manipulate the hardware device.

[0003] Various "hands free" controls have been developed. However, these suffer from many limitations. Those that rely on voice controls typically cannot offer the same level of precision control as through hand controls, and are limited in the number of applications in which they are suitable. Some may rely on camera systems to track user movement. However, reliance on a camera system inherently requires a continual view of the relevant parts of the user at a sufficient resolution, which limits the number of suitable applications for use.

[0004] The subject matter claimed herein is not limited to embodiments that solve any disadvantages or that operate only in environments described above. Rather, this background is only provided to illustrate exemplary technology areas where some embodiments described herein may be practiced.

BRIEF SUMMARY

[0005] The present disclosure relates to computer systems, methods, and computer storage media for using neurological data to generate a continuous motion control ("CMC") and associating the CMC with a user interface control ("UIC"). The CMC is mapped to neurological data generated while a user performs a set of physical movements within a continuous range of motion. The CMC is operable to modulate the associated UIC such that neurological signals/data generated during a user's physical movements within the continuous range of motion serve as input for controlling the UIC in a continuous/analog fashion.

[0006] At least some of the embodiments described herein provide fine, analog control of one or more user interface operations having continuous settings as opposed to a limited number of discrete settings. In some embodiments, a CMC is generated through machine learning and/or regression techniques so that neurological data are converted to scalar numbers as opposed to simply being classified into one of a limited number of discrete categories.

[0007] In some embodiments, a CMC operates through neurological data generated during physical movement of one or more of a hand, foot, face, arm, leg, head, and/or other body part. Exemplary continuous motions that may be associated with a CMC include foot flexion and extension movements, hand rotation movements, facial movements (e.g., smiling, brow furrowing, opening of eyes to various degrees, mouth opening and closing movements), arm raising and lowering movements, and other physical movements that are part of a continuous range of motion capable of being performed by a user.

[0008] In some embodiments, the UIC associated with the CMC is one or more of a display control, audio control (e.g., volume control), navigation control, system setting control, control related to an avatar or one or more other character (e.g., facial expressions or other character movements that track a user's movements), gaming controls, menu control, or other user interface operation or control.

[0009] In some embodiments, a generic CMC is constructed by obtaining neurological data generated by a plurality of users while the users perform various physical movements within a particular range of motion and mapping the obtained neurological data to those physical movements. The resulting generic CMC is then fine-tuned according to a particular user's unique neurological profile to thereby calibrate the CMC as an individualized CMC. Accordingly, the generic CMC is operable as a baseline for efficiently upgrading to an individualized CMC.

[0010] This Summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This Summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended to be used as an aid in determining the scope of the claimed subject matter.

[0011] Additional features and advantages will be set forth in the description which follows, and in part will be obvious from the description, or may be learned by the practice of the teachings herein. Features and advantages of the invention may be realized and obtained by means of the instruments and combinations particularly pointed out in the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] In order to describe the manner in which the above-recited and other advantages and features can be obtained, a more particular description of the subject matter briefly described above will be rendered by reference to specific embodiments which are illustrated in the appended drawings. Understanding that these drawings depict only typical embodiments and are not therefore to be considered to be limiting in scope, embodiments will be described and explained with additional specificity and detail through the use of the accompanying drawings in which:

[0013] FIG. **1** illustrates a computing environment that can be used to generate a continuous motion control for analog control of a user interface control;

[0014] FIG. **2** illustrates a flowchart of an exemplary method for using neurological data to modulate a continuous user interface control;

[0015] FIG. **3** illustrates EEG data representing a generic continuous motion control and individual EEG data generated by a particular user for use in a continuous motion control calibration process;

[0016] FIGS. **4**A-**4**C illustrate operation of an exemplary continuous motion control configured to function according to motion of a user's hand to modulate a volume control;

[0017] FIGS. **5**A-**5**C illustrate operation of an exemplary continuous motion control configured to function according to motion of a user's foot to modulate a virtual pedal;